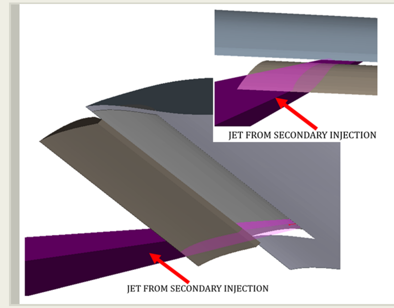
Robust Prediction of High Lift Using Surface Vorticity, Phase I

Completed Technology Project (2016 - 2016)

Project Introduction

Research in Flight is proposing to advance the capabilities of its surface vorticity solver for aerodynamic loads on subsonic aircraft to include more robust solutions for high lift configurations. A compelling capability to accurately calculate lift for high lift configurations such as the NASA EET geometry and the DLR-F11 geometry. Generally, there is an upper limit on lifting surface incident angle past which potential flow solvers such as FlightStream can no longer accurately predict the lift due to flow separation. Furthermore, FLightStream does not currently have the functionality to include features for delaying flow separation such as blown flaps. The inclusion of a pressure difference rule has indicated great promise for using FlightStream ultimately to predict maximum lift coefficient given a reliable model for the separation. This adaptation of FlightStream to "CLmax" calculations is not broadly applicable because of the required empiricism based on discrete pressure points on a wing for a limited number of configurations. For the proposed work, separation criteria will be developed based on a more fundamental physics based analysis driven by surface vorticity rather than limited correlations to surface pressure. This approach will involve three phases of effort. The first phase of the effort will involve simply predicting whether or not flow separation has occurred on the wing to a significant enough level to affect lift. This will give rise to a simple "CLmax" calculation. The second, more advanced phase will identify the flow separation line on the wing based on a maximum allowable vorticity value, and the third phase of the effort will include the release of vortex filaments along this line of separation, resulting in a highly advanced approach for high lift prediction. This effort will be supplemented by blown flap functionality, robust weight estimates for the high lift system and a high lift system design optimization capability.



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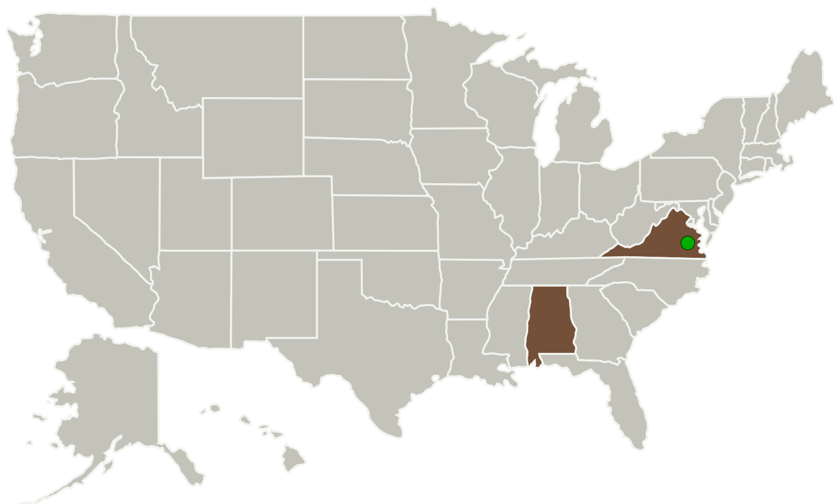
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Research in Flight	Lead Organization	Industry	Auburn, Alabama
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Alabama	Virginia

Project Transitions

June 2016: Project Start

December 2016: Closed out

Closeout Documentation:
- Final Summary Chart*(https://techport.nasa.gov/file/140360)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Research in Flight

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

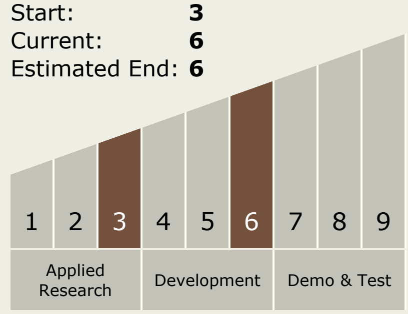
Carlos Torrez

Principal Investigator:

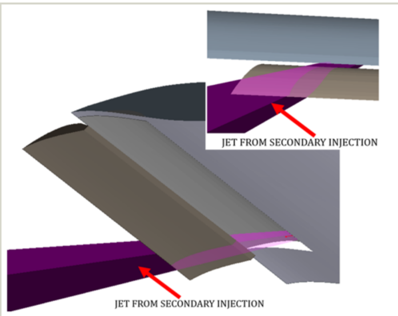
John E Burkhalter

Technology Maturity (TRL)

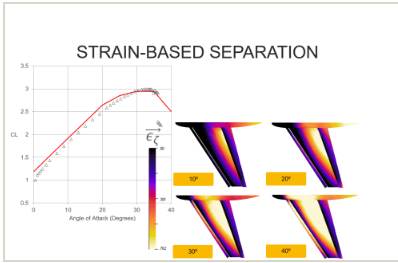
Start: **3**
Current: **6**
Estimated End: **6**



Images



Briefing Chart Image
Robust Prediction of High Lift Using Surface Vorticity, Phase I
(https://techport.nasa.gov/image/130484)



Final Summary Chart Image
Robust Prediction of High Lift Using Surface Vorticity, Phase I Project Image
(https://techport.nasa.gov/image/133395)

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  └ TX15.1 Aerosciences
    └ TX15.1.1 Aerodynamics

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System